US010908732B1

(12) **United States Patent**
Sundara-Rajan et al.

(10) **Patent No.: US 10,908,732 B1**
(45) **Date of Patent: Feb. 2, 2021**

(54) **REMOVABLE ELECTRONICS DEVICE FOR PRE-FABRICATED SENSOR ASSEMBLIES**

(71) Applicant: **Google LLC**, Mountain View, CA (US)

(72) Inventors: **Kishore Sundara-Rajan**, Redwood City, CA (US); **Mauricio E. Gutierrez Bravo**, Santa Clara, CA (US); **Ivan Poupyrev**, Sunnyvale, CA (US); **Alejandro Kauffmann**, San Francisco, CA (US); **Mustafa Emre Karagozler**, London (GB)

(73) Assignee: **Google LLC**, Mountain View, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **16/550,932**

(22) Filed: **Aug. 26, 2019**

(51) **Int. Cl.**

G06F 3/041	(2006.01)
G06F 3/044	(2006.01)
G06F 3/0488	(2013.01)
D03D 1/00	(2006.01)
G06N 20/00	(2019.01)

(52) **U.S. Cl.**
CPC ***G06F 3/04162*** (2019.05); ***G06F 3/0446*** (2019.05); ***G06F 3/04883*** (2013.01); *D03D 1/0088* (2013.01); *G06F 2203/04102* (2013.01); *G06F 2203/04107* (2013.01); *G06N 20/00* (2019.01)

(58) **Field of Classification Search**
CPC G06F 3/04162; G06F 3/0446; G06F 3/04883; G06F 2203/04102; G06F 2203/04107; G06N 20/00; D03D 1/0088
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

8,035,039	B2	10/2011	Cha et al.	
8,373,672	B2	2/2013	Wallace et al.	
8,648,837	B1 *	2/2014	Tran	G06F 3/03545 345/179
2002/0076948	A1	6/2002	Farrell et al.	
2006/0281382	A1	12/2006	Karayianni et al.	
2009/0303602	A1	12/2009	Bright et al.	

(Continued)

FOREIGN PATENT DOCUMENTS

WO WO 2007/137486 12/2007

Primary Examiner — Lisa S Landis
(74) *Attorney, Agent, or Firm* — Dority & Manning, PA

(57) **ABSTRACT**

A removable electronics device for pre-fabricated sensor assemblies of interactive objects is provided. The removable electronics device includes one or more processors, a first communication interface configured to communicatively couple with one or more remote computing devices, and a second communication interface configured to communicatively couple with a plurality of pre-fabricated sensor assemblies having touch sensors with different sensor layouts. The removable electronics module can analyze, in response to being physically coupled to a first pre-fabricated sensor assembly, first touch data to detect one or more pre-defined motions based on one or more first pre-defined parameters associated with the first touch sensor. The removable electronics module can analyze, in response to being physically coupled to a second pre-fabricated sensor assembly, second touch data to detect the one or more pre-defined motions based on one or more second pre-defined parameters associated with the second touch sensor.

20 Claims, 37 Drawing Sheets